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NAIC-ID(RS)T-0247-96

HUMAN TRANSLATION

NAIC-ID(RS)T-0247-96 20 September 1996

MICROFICHE NR:

SELECTED ARTICLES

English pages: 19

Source: Zhongguo Hangtian (Aerospace China), Nr. 186, October 1993; pp. 14-19

Country of origin: China
Translated by: SCITRAN
F33657-84-D-0165
Requester: NAIC/TASS/Capt Paul Woznick
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CURRENT STATUS AND FUTURE OF RUSSIAN
COMMUNICATIONS SATELLITES

He Wen

Currently, Russia does very little resecuring of its communications satellites. On the one hand, this is in order to stimulate foreign interest and, going a step further, obtain financial aid. On the other hand, it is also to promote foreign cooperation. The former Soviet Union is, at the present time, the nation which has launched the most communications satellites.

Up to 1992, 127 of the Lightning-1 and Lightning-3 satellites alone were launched. Due to the fact that operation and launch costs of Russian communications satellites are low, when satellites develop malfunctions in orbit, there is no need to carry out repairs on them. It is only necessary to launch a new satellite to take its place. Orbits which were utilized by the former Soviet Union's military use and civilian use satellites included low earth orbits (1500km or even lower), high apogee elliptical (illegible) orbits (500-39900km), as well as geostationary orbits. Following along with the disintegration of the Soviet Union, how many of the future projects which they previously announced will, in the final analysis, be dropped from realization is still an unknown number. Russia currently has the satellite systems seen in Table 1.

LOW EARTH ORBIT MILITARY SATELLITES

There are three catagories among Russia's low earth orbit military satellites. Among these, two types opt for the use of Cosmos rockets for launches. These went into service in the 1970's. The lowest satellites operated in quasicircular orbits at 800km. Angles of inclination were 74°. The coverage range was extremely broad. This type of "storage-transmission" communications satellite is able to take information sent by transmiters outside the country and store it. When the satellites go through Russian air space, the information is taken and sent out again. It is said that, during the Cold War period, it was no one other than Soviet spies who made use of this type of satellite system to take information and transmit it to their superiors. The satellites in the systems in question were distributed in 3 orbital planes. The angles included between the planes were 120°. However, at the present time, it is still not clear how many satellites were in opeation in each orbital plane at the same time.

The structures of Russia's first generation communications satellites were simple. The dimensions were small. One Cosmos rocket was capable of sending 8 satellites into quasicircular orbits at altitudes of 1500km and angles of inclination of 74° at the same time. The 8 satellites were coplanar. The orbital

periods were slightly different. First generation communications satellite systems were used in communications contacts between battlefield commanders and their superiors, going through small model mobile systems.

Second generation battlefield communications satellite systems began experimental deployment in 1985. Satellites were sent to 1400km by high thrust Whirlwind-3 rockets from Puliexieke (phonetic) launching site. Orbits had angles of inclination of

Table 1 Table of Russian/Soviet Communications Satellites Currently on Hand

System Nomenclature	Standard Orbital Data	Satellite Nomenclature	Application Scope
None	74°/800km	Cosmos	Military Use Storage Transmission Type Communications Satellite
None	74°/1400km-1500km	Cosmos	First Generation Military Use Communications Satellite. 8 Satellites to One Launch.
None	82.6°/1400km	Cosmos	Second Genera-

			ation Military Use Communications Satellite. 6 Satellites to One Launch.
Orbit	63°/500-39800km	Lightning-1	Civilian Use Communications. Rumor Has It That It Is Currently Primarily Used for Military Matters.
		Lightning-3	Domestic and International Civilian Communications.
Stationary	GEO Orbit	Rainbow	Military Use Communications (Rainbow 1)
		Flourescent Screen	Direct Domestic Television Broadcast
		Horizon	Domestic and International Civilian Communications
Gals	GEO Orbit	Rainbow	Military Fixed Point

			Communications
Luch	GEO Orbit	Horizon	Fixed Point Communications. May Be for Civilian Use.
Luch-P	GEO Orbit	Rainbow	Fixed Point Communications. May Be for Military Use.
Luch/SDRN	GEO Orbit	Cosmos	Earth Space Earth and Space Earth Data Relay
MORE	GEO Orbit	Horizon	Mobile Station Communications. Uses At the Present Time and in the Future Are Still Not Clear.
Photon	GEO Orbit	Horizon	Data Relay Communications. May Be Primarily for Military Use.
Volna	GEO Orbit	Rainbow	Aviation and Mari-

Horizon time Mobile Communications.

82.6°. Second generation satellites had to be heavier than first generation satellites. Therefore, one rocket launched 6 satellites. Although orbits were low, due to the fact that angles of inclination were large, however, coverage ranges were necessarily broader than the first generation.

LIGHTNING COMMUNICATIONS SATELLITES

Lightning satellites are Russia's first satellites used in radio, telegraph, and television communications. They were launched in 1965. Due to the fact that carrier rocket lift capabilities and the geographical locations of launch sites are limited, Lightning satellites opt for the use of orbits where perigees are 400-600km and apogees are 39860km. Orbital angles of inclination were initially 65°. They were later altered to be 63°. This orbit was decided on when Lightning satellite systems were designed in the 1960's. At that time, the Soviet Union still did not have the capabilities associated with taking useful loads and sending them into geostationary orbits. In each orbital period of Lightning satellite operation, it is possible to carry out 8-10 hours of communications. There is no capability to stay in relatively stationary configurations 24 hours, similar to geostationary orbit satellites. However, this type of orbit also has its advantages, that is, speaking in terms of relatively geostationary orbits, useful loads are relatively larger. In conjunction with this, it is possible to provide coverage in polar regions.

In order to make Lightning satellite systems capable of carrying out 24 hour communications coverage, Russia takes Lightning satellites and distributes them in 8 orbital planes including between them angles of 45°.

By the end of 1992, Russia had launched a total of 84 Lightning-1 and 43 Lightning-3 satellites. The former are used in government and military communications. The latter are for civilian use.

GEOSTATIONARY ORBIT SATELLITES

Due to the fact that geostationary orbit satellites are capable of providing 24 hour communications coverage, Russia set up a stationary satellite network operating in geostationary orbits. In December 1975, Russia made use of the Proton rocket to launch for the first time Rainbow satellites into geostationary orbits in a satellite network. After this, stationary satellites then took the designations of Flourescent Screen (later changed to be Flourescent Screen M), Horizon, and Rainbow-1 for transmissions.

Rainbow, Flourescent Screen, and Horizon satellites all have dedicated fixed longitudes, representing the different systems being operated. Rainbow and Rainbow-1 are primarily used in government and military communications. Following along with an impetus associated with the commercialization of Russia's space program, Rainbow has the capability to be turned to civilian uses. The fixed point associated with Flourescent Screen and Flourescent Screen M satellites is 99°E. They are used in domestic direct broadcast communications. Horizon, by contrast, is used in international civilian communications, including those between various independent confederated nations.

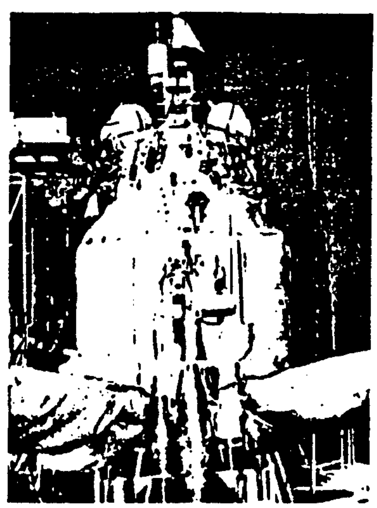


Fig.1 Lightning 3 Satellite

Besides these, Russia has a number of other satellite systems in the Geneva international communications federation register--for example, such systems as Gals, Luch, as well as Volna, and so on. However, they are not independent satellites but are transmiters carried additionally by stationary satellite systems and nothing more.

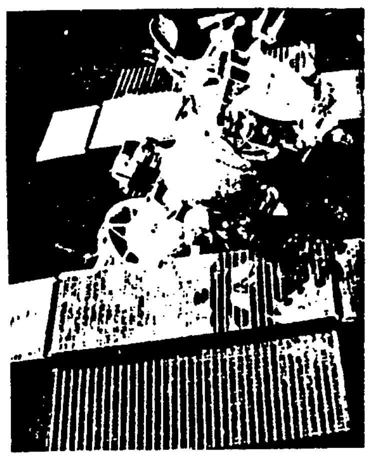


Fig.2 Horizon Satellite

Satellite series launched into geostationary orbits are all designated Cosmos. Among these, a number of different Photon data relay satellites correspond. Another group are, by contrast, designated as Luch data relay satellites (SDRN). These are the same as U.S. tracking data relay satellites (TDRS). There are now 4 Photon/Cosmos satellites and 2 Luch/Cosmos satellites operating in orbit.

In geostationary orbits, a set of Cosmos satellites sit idle at a fixed point 25°W. These satellites were possibly used in carrying out early warning with regard to the status of Western missile deployment. Another set of Cosmos satellites in orbit implement the Prognoz remote sensing plan. In this, 2 satellites were recently positioned at 24°W.

FUTURE LOW EARTH ORBIT COMMUNICATION SYSTEMS

Before the disintegration of the Soviet Union, preparations were made for the deployment in the 1990's of a series of communications satellite systems. However, following along with its disintegration, it is still unclear whether or not it will be possible to continue the implementation of these plans. Due to Russia's unremiting budget reductions, it is only through cooperation and commercialization as well as the obtaining of foreign funding that it will be possible to make these projects achieve fruition.

As far as low orbit satellite system projects which have been promulgated at the present time are concerned, one is Messenger. This system has 4 orbital planes. Each plane has 6 satellites. It is projected to increase to 6 orbital planes later.

Cosmos 2199 and 2201, which were among 6 military use satellites that were launched in July 1992 (Cosmos 2197-2202), were Messenger test satellites. Messenger is expected to begin opeation in 1993. It will go into a normal operating configuration in 1995. /16

Another low orbit satellite system is the Koskon system. The test satellite was launched in February 1991 (illegible) with the name Infomatr 1. It was originally decided to make use of Zenith 2 and Cosmos rockets to launch Koskon satellites. The system in question has 4 orbital planes. Each plane has 8 satellites. Zenith 2 can take 8 satellites and launch them into orbit at one time. If satellites develop malfunctions, then replacement satellites can be launched by Cosmos rockets.

At the present time, plans associated with the utiliztion of Puliexiecike (phonetic) launching site to launch Zenith 2 rockets have already been postponed. For this reason, it has led to Koskon satellites changing orbits. There are no Zenith 2 rockets. Cosmos rockets have great difficulty deploying satellite systems with weights of 600kg. There is a possibility of using Zenith 2 rockets launched from Qiulatan (phonetic) firing site to launch Koskon satellites. However, Zenith 2's have never before launched satellites with angles of inclination as large as this. Moreover, here, there are also problems in the area of launch site safety.

FUTURE GEOSTATIONARY ORBIT SATELLITES

Among the satellite systems set out in Table 2, there are at

least two types of transmiters used by satellites which are installed on satellites associated with other types of uses. There are a number of satellite systems that are already registered, including among them the More network (mobile satellite communications) and the Tor system (mobile communications making use of frequencies associated with military uses). These will opt for the use of transmiters on specialized satellites and other satellites.

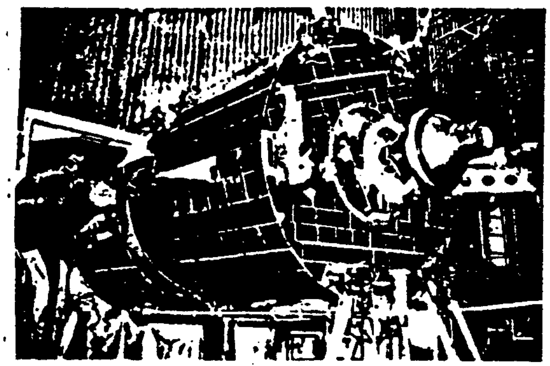


Fig.1 Messenger Satellite

It is currently planned to improve stationary civilian use communications systems, making them capable of use in communications between independent federated entities and international communications. However, there is no unity of

Table 2 Table of Russian/Former Soviet Union Future Satellite Systems

System Nomenclature	Standard Orbit Information	Satellite	Project Status
Messenger	82.6°/1000km	Cosmos?	Electronic Communications, Voice Communications , Facsimile, Telemetry
Koskon	83°/1000km	Cosmos?	Telephone, Teletype, Digital Transmission
Marafon	63°/500-39800km	Mayak	Mobile Communications, Telephone, Telegraph
	GEO Orbit	Arkos	Mobile Communications, Telephone, Telegraph
Ekspress	GEO Orbit	Ekspress	Domestic and Inter-

			national Communications. Takes Place of Horizon.
Foton	Geo Orbit	Foton	Data Relay
STV 12	Geo Orbit	Gals	Domestic Communications. Takes Place of Flourescent Screen/Flourescent Screen M.
	Geo Orbit	Gelikon Floures-cent Screen/ Flourescent Screen M	Domestic Communications. May Take Place of Gals.
Granit	GEO Orbit	Granit	May Replace Horizon.
MORE	GEO Orbit	(Horizon)	Mobile Station Communications. Can Be Used Together With Current Horizon.

Romantis	GEO Orbit	Romantis	Cooperative Project With Germany. Used in Voice, Data, and Television Broadcasts.
SSRD 2	GEO Orbit	Cosmos?	May Be Second Generation Data Relay Satellite. Replaces Luch/SDRN.
TOR	GEO Orbit	Rainbow (Horizon)	May Be Used in Military Mobile Communications.

viewpoints on how to make the improvements. There are two satellite systems which will take the place of Flourescent Screen/Flourescent Screen M and Horizon systems. At the present time, it is still not clear whether or not one is a replacement system of a temporary nature and will later be replaced by another permanent, more effective system, or it will only be the original project crowned with a new title.

Gals is not only a transmiter on Rainbow satellites. It will also function to replace the specialized domestic communication satellite systems associated with Flourescent Screen. The systems in question are all capable of launch as required. Gals makes use of extra propellent carried along to

apply control with respect to orbital angle of inclination. Gelikon can only begin operations after 1996-1997. It will carry 4 Ku wave band transmiters. This is Russia's first use of this type of transmiter. /17

The Horizon replacement systems are Granit and Ekspress. Granit is capable of carrying at least 22 antennas. These antennas and 18 or even more transmiters are interconnected, providing a wide range of communications. Its standard useful load includes 10 C wave band transmiters. 5 Ku wave band, and 3 L wave band transmiters. It is also capable of carrying K/Ku wave band transmiters. L wave band transmiters are appropriate for use with airborne, maritime, and land users to carry out mobile communications in accordance with international maritime satellite standards.

Ekspress is a replacement satellite for Horizon. Its fixed points will be at 40°E, 103°E, and 145°E. At the present time, there are two Horizon satellites fixed respectively at points 40°E and 103°E. What is different from replacement systems for Flourescent Screen is that Horizon replacement systems make use of the positions of replaced satellites. They will be used in television broadcasts, telephone, telegraph, and data relay transmissions. Besides this, before the disintegration of the former Soviet Union, among registered satellite systems, there were also 2 data relay satellite systems, including 3 Foton satellites positioned at 81.5°E, 169.5°E, and 15°W.

Second generation space space global data relay system (SSRI 2) projects are also not completely clear. The registered locations are 77°E, 167°E, and 16°W. The first two positions are exclusively used by SSRD 2. At the present time, due to SDRN system costs being too high, it is still not possible to go into service. SSRD 2's prospects are, in conjunction with that, not bright.

Marafon communications satellite systems are composed of two parts. One includes 2-4 Mayak satellites. Orbits are close to those of Lightning. The other has 3-4 Arkos stationary orbit satellites. The system in question was originally planned for launch in 1992. However, up to the present time, this has still not yet been carried out. Because 8 Lightning-1's and 8 Lightning-3's are just in the midst of orbital operations at the same time--speaking in terms of Marafon systems--adding transmiters to Lightning satellites is somewhat more rational than launching specialized Mayak satellites.

The registered positions for Arkos satellites are 85°E, 170°E, and 14°W. Among these, 170°E is exclusively used by Arkos. Marafon communications satellite systems are primarily to supply communications for petroleum and geological personnel in remote areas.

What must finally be talked about is the Romantis system. The system in question was put forward in 1989. It is a system which was developed with joint funding from several companies. This system will provide fixed satellite communications services as well as Ku wave band telephone, broadcast, data, and television transmission services. As far as Russian law is concerned, it is still unclear whether or not it is also possible to carry this project out.

One important problem which exists universally with Russian communications satellites is that the service life of specialized satellites is much shorter than for Western satellites of the same type. In order to be able to operate normally and, in conjunction with that, provide 24 hour communications coverage, it is necessary to carry out launches continuously. However, costs associated with each launch iteration for them will be much smaller than in the West.

In summary, most of the communications satellite systems which the former Soviet Union set up are still in operation. The scope of applications goes all over the world. Despite this, because of funding problems, a good number of projects which were announced before the disintegration of the former Soviet Union, at the present time, still have prospects that are difficult to predict. Russia may deploy a new domestic communications satellite system. However, time periods must be postponed relative to those originally set. The futures of project development and systems deployment are, in all cases, dependent on whether or not Western companies are willing to cooperate with Russia.

An attractive proposal, which Russia has put forward, is to offer for sale complete sets of Horizon satellites and 4 stage Proton carrier rockets. Horizon satellites are launched from Qiulatan (phonetic) and Baikenuer (phonetic) launch sites. After they enter into quasisynchronous orbit, satellite control and all other operating arrangements are handed over as responsibilities of the customer.

INTERNATIONAL MARITIME SATELLITE 3

He (Illegible)

Translation of "Guo Ji Hai Shi Wei Xing 3"; Aerospace China, No.10, Oct 1993, pp 18-19

The international maritime satellite organization has already become a world leader in the area of providing satellite communication services to maritime and land users. At the present time, it is providing mobile communications services for 65 nations, 11000 vessels, and constantly increasing aviation and land mobile subscribers.

In early 1991, the Matela-Makeni (phonetic) company obtained a contract with a Britich communications electronics company (illegible) to develop a third generation international maritime satellite 3. According to plans, 4 satellite launchs will begin in August 1994. As far as the satellites in question are concerned, these satellites will operate in stationary earth orbits.

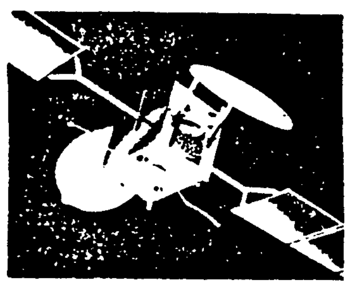


Fig.1 International Maritime Satellite 3

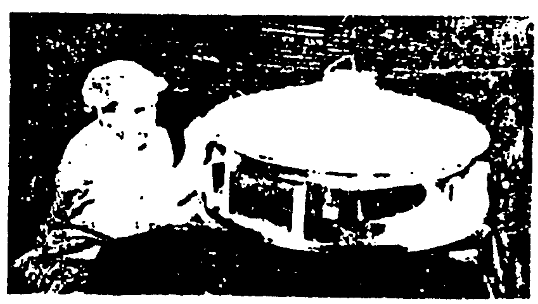


Fig.2 Navigation Antenna in the Process of Testing

Fig.3 International Maritime Satellite 3 Navigation Antenna

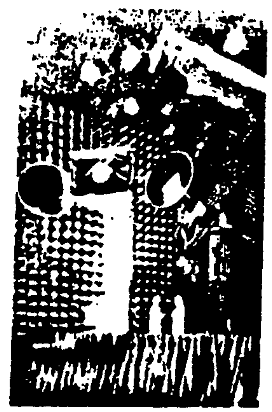


Fig.4 Useful Load Model in Testing

The effective load in International Maritime Satellite 3 will opt for the use of a good amount of new equipment, thereby making itself better than the previous two generations of satellites in all such areas as performance, weight, cost benefits, and so on. In particular, it will opt for the use of newly developed solid power amplifiers. This type of power amplifier has small volume, light weight, high power, and good technical characteristics. The L wave band antennas which are used opt for the utilization of new designs. As far as opting for the use of this new equipment is concerned, technical discussions were carried out in all cases before signing contracts.

In the world 10 years in the future, requirements for satellite communications channels will increase without ceasing. As a result, it is necessary to bring to bear to the maximum extent the efficiencies of each satellite. The earliest

communication satellites opted for the use of global coverage beams. However, due to the fact that the population of the world is not evenly distributed, some areas basically have no one living in them. Therefore, opting for the use of global coverage beams is very wasteful. The method for solving this is to opt for the use of point beams. The areas of coverage are the ones that need to have communications services provided the most. Although there is already nothing new about this type of solution, International Maritime Satellite 3, however, gives the most consideration possible to communication requirements in areas such as wave forms and powers. In conjunction with this, it is possible, on the basis of changes in requirements, to carry out adjustments--even to the point where it is also possible to carry out adjustments of satellite orbital positions on the basis of requirements.

Communications useful loads include two independent transmiters. Forward directional transmiters take ground station C wave band signals and convert them into L wave band signals. In conjunction with this, transmissions are made to mobile users. Reverse directional transmiters receive user L wave band signals, converting them into C wave band signals, after which, transmissions are made to ground stations. Ground stations take mobile users and interconnect them with public switching networks. Useful loads on satellites are also capable of acting as navigation equipment. Use is made of L wave band antennas on them to carry out global positioning.

At the end of 1992, the development phase for International Maritime Satellite 3 concluded. Beginning in 1993, over 600 pieces of equipment began to go into production. Among these, more than 400 pieces were manufactured by the Matela-Makeni (phonetic) company. Most of these pieces of equipment, which have already begun to be manufactured, are newly developed. Among these are included solid state power amplifiers, frequency generators, and new model antennas, electric power supply systems, as well as low noise amplifiers.

Equipment which is manufactured will be fully assembled at Portsmouth in the U.K. After that, in the fall of 1993, it will be sent to the British Communication Electronics company. Later, one full useful load assembly will be completed every 4 months.

Main performance indices associated with International Maritime Satellite 3 are as follows:

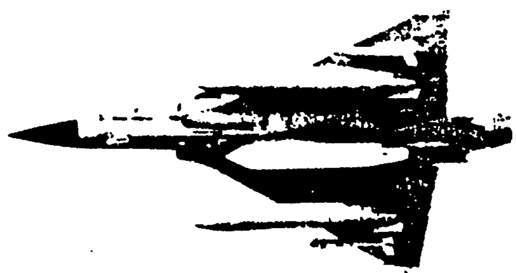
Dimensions: 2.1mx1.8mx1.7m
Solar Power Battery Wing Span: 16.7m
Satellite Net Weight: 772kg
Useful Load Weight: 150kg
DC Power: 2300 W
Design Life: 13 years
Wave Bands: L (mobile communications)
C
L (navigation)

THE MATELA (PHONETIC) COMPANY PREPARES TO DEVELOP A SUPER BRIGAND C MISSILE

Ying Xiao

Translation of "Ma Te La Gong Si Zhun Bei Yan Zhi Chao Ji Qiang Dao C Dan Dao"; Aerospace China, No.10, Oct 93, p 19

France's Matela (phonetic) company recently announced that it is in the process of carrying out a high accuracy, multiple function, defense area externally launched cruise missile project--that is, it is preparing to develop a super Brigand C missile.



France's Matela (Phonetic) Company Prepares to Develop a Brigand C Missile in Order to Equip Mirage 2000N Fighters

In early 1993, the Matela (phonetic) company began to develop a Brigand missile to equip Mirage 2000N. At the present time, progress on development work is smooth. At the end of this May, the first Brigand missile launch tests were carried out. In conjunction with this, preparations were made with regard to carrying out the first launches of Brigand missiles carrying power and guidance systems early in 1994. It is projected that, in 1996, it will be possible to complete work integrating Mirage 2000D and Brigand. Large batch production of counter runway models of Brigand missiles will begin in 1997. This type of missile will be used in equiping France's air force. The accuracy is 15-30 meters. Ranges are capable of reaching 150km.

Brigand missiles will also be launched from the sea and surface vehicles. This type of suface launch model missile will add two boosters.

New models of super Brigand C missiles are a type of air launched subsonic missile fired outside defense areas, which are created by improvements added onto the foundation of the Brigand

missile. They are capable of being used in carrying out various types of different missions. Weight is 1230kg. Combat section weight is 450kg. Accuracies can reach 1-3 meters. Ranges are capable of reaching 400-600km. During cruising flight, Brigand C missiles are controled by radar altimeters. In conjunction with this, infrared guidance heads are added onto radar guidance in order to make relevent guidance imagery even more precise. It is possible to do precision positioning beyond 5 kilometers with regard to ordinary targets. Brigand C is capable of carrying out attacks in depth against strategic and political targets. In conjunction with this, it is possible to accurately destroy targets and civilian facilities will not be harmed.

According to estimates, at the present time, the French market requires an initial batch of 200 of this type of missile. However, their overall requirement may be 750 units. Responsible people associated with the Matela (phonetic) company hope that the Brigand C will be able to be listed in preparation plans. In conjunction with this, determination will be made in 1993 on whether or not to go forward with development in order to facilitate introduction into service before the year 2000.